DXer

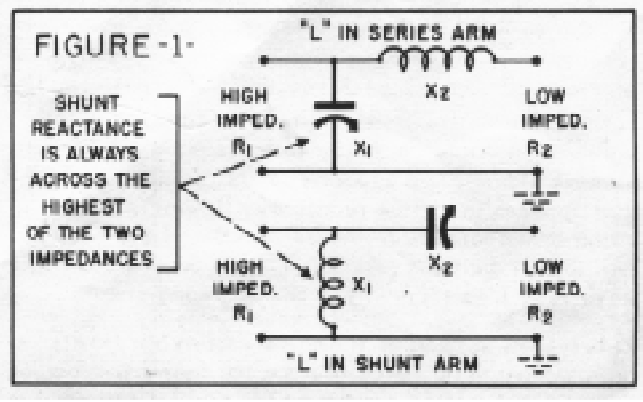
NORTHERN CALIFORNIA DX CLUB

If It Won't Match, to "L" With It!!! By Bud Bane, W6WB

The following article by Bud Bane, W6WB first appeared in Feb. - Mar. 1955 issue of Tecnews, *which was published regularly by Elmar Electronic Supply. It was sent to us by Chuck Patterson, K6RK and is reprinted here in the hope that you will find it to be as interesting and informative as I did.* -Ed.

Let it be said at the outset that the "L" network is one of the most flexible and adaptable of the entire RF impedance matching network series. In its favor is the fact that the L network will have lower losses in a particular application than will the much more familiar "pi" type. For these and other reasons, the subject has been deemed of sufficient importance to warrant a full-length presentation. To this end, the bosses Elvin and Mario have relinquished their interior ad page so that the writer could present all possible information in the space available. Now to the subject proper.

The "L" network looks symbolically like an inverted letter "L" and includes two reactive elements, one in the series arm, the other in the parallel arm. See Fig.1.



It is important to note that the network arms are specified in terms of reactance rather than in inductance and capacity. This makes possible network design formulas that are independent of frequency. A given network with a certain impedance transforming ratio can therefore be operated at any frequency by converting the inductive and capacitive reactances into their equivalent L and C values.

HOW IT OPERATES: L networks depend for their operation upon a well-known electrical rule, namely: that each combination of a resistance and reactance in parallel has an exact equivalent consisting of a resistance and reactance in series. This rule is applied practically in the following manner: Two resistances, (impedances) are always known, the load you have and the load that is to be marched. Obviously, one of these resistances is always higher than the other. The two known resistances are utilized in a formula to determine the value of reactance, which must be placed in parallel with the higher of the two so that the equivalent series circuit contains the

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General Meeting
September 12, 2002

Harry's Hof Brau
1909 El Camino Real,
Redwood City

Program
To be Announced
Stay tuned to W6TI

Social Hour ..	**6:00 P.M.**
Dinner	**7:00 P.M.**
Meeting.....	**8:00 P.M.**

2002 - 2003

Dues are Due

See Page 2

N O R T H E R N
C A L I F O R N I A
D X C L U B

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Secretary: Doug Westover, W6JD
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Club Repeater, W6TI/R
Frequency/offset: 147.36 MHz, +
Trustee: Bob Vallio, W6RGG
Control Operator: Robert Smithwick, W6CS
Club simplex: 147.54 MHz (suggested)
Thurs. Net OTR: 8 pm local time.
Net Manager: Randy Wright, W6CUA
DX News: Net Control Operator
Swap Shop: Mitch Cipriano, AE6AI
QSL Information: Mac McHenry, W6BSY

W6TI DX Bulletins:
W6TI Station Trustee Bob Vallio, W6RGG, transmits DX information at 0200 UT every Monday (Sunday evening local time) on both 7.016 and 14.002 MHz.

Club address: Box 608
Menlo Park, CA
94026-0608

The DXer is published monthly by the Northern California DX Club and sent to all club members. Unless otherwise noted, NCDXC permits re-use of any article in this publication—provided The DXer and the article's author are credited.

Vice President's Comments

Looks like there's some life in the club after all! Dick, N7RC has volunteered to revive the annual club Marathon and has generated numerous comments as to why the Marathon has withered. My own take is a lack of publicity. So beginning now I will try to rectify that.

Remember; our Marathon starts December 1st and ends January 31st. The rules are simple: work as many counties as you can. QSL's not needed. I think there are three categories: phone, CW and mixed. Let's hope the sun cooperates and conditions improve. The decision to move the Marathon from summer to winter was a good one. Have you heard any good DX lately? The Holidays shouldn't divert our attention too much. Dick has promised some ideas, so stay tuned!

The Swap Shop on Thursday evening is showing signs of life, too. Mitch, AE6AI has taken over from Ben, W6FDU.

It's not too early to think about Visalia 2003. Let George, W6YD or Jerry, K6MD know you are ready for assignments.

There will be a Board of Director's meeting at W6VG's home at 10 am, Saturday, August 24th. Let Ron know if you plan to attend as a visitor.

Our next club meeting will be at Harry's Hofbrau in Redwood City on Thursday, September 12th. The program is being developed. If you have ideas or requests for future programs, please let me know.

Don't forget the Christmas party December 14th. Mark your calendars. Rolph, W6TWO is putting this together.

Dues are due! If you haven't already done so, send them to box 608 before the cut off date of September 1st.

Oh yes, we still need a President!

73, Chuck, K6RK.

NCDXC Dues Information

Full and Associate Members;

Date Dues are Paid	Member	Family Rate
1 July thru 30 September	$24.00	Plus $15.00
1 October and after	$24.00	Plus $15.00

*Members who have not remitted dues by the 30 September deadline are considered dropped from the membership roles. Those desiring to renew membership may do so anytime, but will not be included in the new issue of the NCDXC Roster .

Absentee Member Dues are $16.00 per year.

...To "L" With It !!!

(Continued from Page 1)

lowest resistance term. A second simple formula gives the required value of reactance for the equivalent series circuit. The design parameters of L networks are such that operation is on an "all or nothing basis". That is, the assumption is made that the generator, (a vacuum tube for example) is to work into a load equal to its own resistance. Under these conditions maximum power transfer, (full coupling) will result when the network is properly tuned. Coupling can be controlled with a pi network but not with an L. While it is possible to achieve an exact impedance match, (at one frequency) with the L network, the output will never be a pure resistance if reactances in both parallel and series arms have the same sign. (i.e., are both inductors or capacitors.) In practice the network is made resistive by using an inductor in one arm, a capacitor in the other.

Since it is the purpose of this paper o provide information that can be applied quickly and practically, mathematical manipulation has not been given. The accompanying charts (see Table 1. on Page 5) should be adequate for the great majority of amateur applications where L networks can be utilized. Basic formulas are given for those who prefer to "Roll their own". The formulas do show certain important information however, which is interpreted for the non-mathematical reader as follows:

(1)- The parallel reactance always connects across the higher of the two impedances involved.

(2)- The value of this shunting reactance, (1) depends upon the arithmetical value of the impedance across which it is connected. This is to say that, regardless of the impedance ratios involved in the network, when the impedance is high, the value of X will be greater than when the impedance is low. Since the shunting reactance will be a capacitor in most cases, it is important to observe that the lower the reactance, the larger the capacity. Take for example, two networks each with a 10:1 impedance ratio: "A" matches 1000 to 100 ohms, "B" matches 100 to 10 ohms. The formula shows that the necessary shunting reactance for "A" will be substantially higher than that required for "B". In terms of capacity, "A" shunting capacitor will be much smaller than the capacitor in "B".

(3)- The "L" network is a two-way device . . . it may be used to transform impedances up or down, provided only that (1) is observed. Practically, a 10 ohm beam may be matched to a 50 ohm line or a 50 ohm line to a 1500 ohm antenna base impedance.

ADVANTAGES . . .USES: L networks can be designed to match virtually any two differing impedances. While not strictly pertinent to this discussion, it should be stated that whether or not a network, (L or otherwise) is used in a particular circuit will depend to a great extend upon the loss present under the existing mis-matched condition. To clarify, both pi and L networks utilize inductors, even the best of which must have some loss. It follows then that if the gain due to perfect match is a matter of a fraction of a dB, there would seem to be little point in using a network that might, (due to inductor losses) introduce an equivalent or even greater loss.

The L network does offer distinct advantages in many applications where the loads to be matched are not pure resistances but contain a small reactive term. (For example, a ground plane antenna that is not exactly resonant at the desired operating frequency.) In such cases, the L can affect an exact impedance match and bring the VSWR on the line to unity by canceling out the reactance existing at the antenna feed point. This is accomplished by increasing or decreasing the value of the network reactive arms. Practically speaking, an antenna that appears capacitive reactive will cancel some of the inductance in the series arm of the network thereby requiring a larger value of inductance in order to reestablish correct network tuning. The opposite is also true. An antenna that appears inductive reactive will require a smaller value of inductance in the series arm of the network. All things being equal, an L network will always have less loss than a "pi" or "T" type network.

This type of network is therefore preferable for all impedance matching applications other than from vacuum tube to load. It is undesirable in the latter application since full power is always drawn from the tube.

L networks are of particular advantage where multiband operation of a single vertical antenna is contemplated. An exact match, (at a single frequency) to a 52 ohm coax line can be achieved regardless of whether the antenna base impedance is higher or lower than that of the coax line.

LIMITATIONS: There are certain sets of operating conditions, (particularly evident on the HF bands, i.e., 10, 6, 2 meters) where an L network is impractical in the sense that the necessary values of reactance cannot be achieved. In this regard, the inductance is generally the troublesome element since in some instances it may become vanishingly small. A typical example: Match a 10 ohm beam to a 50 ohm line at 10 meters. The calculations show the parallel capacitor to be 227 micromicrofarads, the inductance to be .11 microhenries. If this low value of inductance is to be obtained at all it will probably be in the form of a hairpin rather than of a conventional multi-turn coil. Another consideration is that the leads necessary to connect the network to the driven element of the beam may, in themselves, have more than the required inductance. Since it is normally considered advisable to provide balanced feed to a beam, the network should operate in conjunction with a balun and should therefore be a balanced, rather than a one-side grounded type. This means that one-half of the total calculated induc-

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...To "L" With It !!!

(Continued from Page 3)

tance must appear in each series arm, twice the calculated capacity in each shunt arm with the mid-point connected to ground. The absurdity of attempting to make an already too small inductor smaller yet is quite apparent.

TUNING AN "L" NETWORK: Since these networks are virtually always operated in conjunction with a transmission line, proof of proper network tuning can be best determined by checking the standing wave ratio on the line. As stated, an L network can achieve a perfect match, (unity standing wave ratio) at a given frequency, assuming that the network constants can compensate for reactance present in the load. An L network cannot be tuned by observing amplifier loading as the network constants are changed!

Note that both L and C must be varied in order to establish correct network tuning. In practice, an arbitrary setting of L and C will yield some value of SWR. L should then be changed and C rotated through its range watching the SWR for a downward trend. Ultimately, the inductance value will be such that the SWR will drop to unity at some capacitor setting. (This assumes that the capacitor has a sufficient maximum value.) Reactance present in the load may cause both inductance and capacity to vary markedly from values determined by formula. In summary, don't try to tune an L network by amplifier loading or by "S" meter reading where the network is to match a line to the receiver input. Use a standing wave bridge and a low-power source of bridge excitation. A fraction of a watt won't hurt the RF coils in your receiver. In the latter case, do make certain that your SWR is always brought to its lowest value by adjustment of the RF antenna trimmer since the receiver input should present a resistive load to the network.

In applications where the network is called upon to match a line to the driven element of a parasitic beam, consideration must be given to the possibility that the network will be seeing both resistance and reactance. Unity SWR can still be achieved but the network constants will depart from those determined by formula. L and C can become larger or smaller than the design values depending upon the magnitude and sign of the reactance present in the driven element of the beam antenna.

In one practical instance, a calculated and subsequently measured 5 turn series inductor required 7 turns to produce unity SWR when installed in the network to match a 52 ohm line to the driven element of a 3 element 20 meter beam. The shunting variable capacitor also required some readjustment. It is thus apparent that both L and C should have plus or minus adjustment leeway in all cases where a line is to be matched to an antenna by an L network.

Analysis of network branch currents indicates that the current through the series reactance will be higher than that through the parallel reactance. The difference is fairly marked at low impedance ratios, less so at high ratios. Network losses for certain impedance ratios can therefore be decreased somewhat by using an inductor in the parallel arm, a capacitor in the series arm. At high impedance ratios, X_L and X_C are virtually equal, i.e., the combination is near resonance. L can therefore be determined readily by conventional grid dip methods when C is known. □

Map and Directions to Meeting

Harry's Hof Brau is fairly easy to find. It's on El Camino Real, just north of Woodside Road (Highway 84).

From Highway 101, take the Woodside Road (Highway 84) West exit to the El Camino North exit. Follow that exit (a short distance) toward El Camino to the stop sign at Main Street. You will practically be in Harry's parking lot! It will be right across the street on your left.

From Highway 280, take the Woodside Road East exit and follow it to the El Camino North exit. Harry's will be on your right just past the underpass.

There are parking lots on both sides of the building. So, if one lot is full, just try the other one.

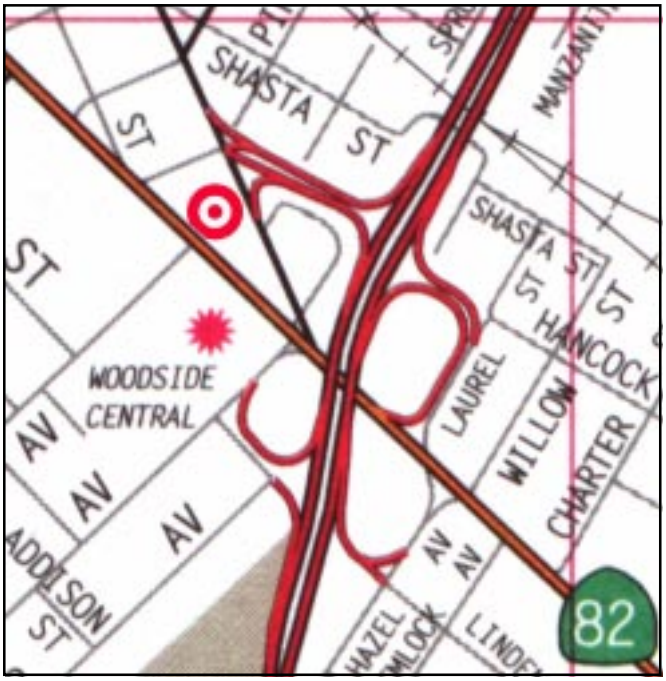


Table 1.

"L" Network Values at 14 MHz for Various Mis-match Impedances

R_1	R_2	X_1	X_2	X_1 = C	X_2 = L	freq.
50	10	25	20	454	.229	14
50	20	38.8	24.6	292	.28	14
100	50	100	50	113.5	.526	14
200	50	116	86.7	97.9	.975	14
300	50	134.4	113	84.5	1.28	14
400	50	151.6	132.5	75	1.5	14
500	50	167	150	67.5	1.71	14
600	50	180	166	63	1.88	14
700	50	193.2	181	58.8	2.06	14
800	50	204.8	194	55	2.2	14
900	50	216.9	206	52.4	2.32	14
1000	50	228	218	49.8	2.55	14
1500	50	277.5	270	41	3.06	14
2000	50	316	313	36	3.59	14
2500	50	352.5	351	32	4.09	14

R = OHMS, X = OHMS, C = μμf, L = μh, f = MEGACYCLES

for 3.5mcs - multiply L and C by 4

for 7mcs = multiply L and C by 2

for 21 mcs = divide L and C by 1.5

for 28 mcs = divide L and C by 2

FORMULAS

$$X_1 = \sqrt{\frac{R_1^2 \times R_2}{R_1 - R_2}}$$

$$X_2 = \sqrt{R_1 \times R_2 - R_1^2}$$

$$C\mu\mu f = \frac{1{,}000{,}000}{6.28 \times f_{mc} \times X_{ohms}}$$

$$L\mu h = \frac{X_{ohms}}{6.28 \times f_{mcs}}$$

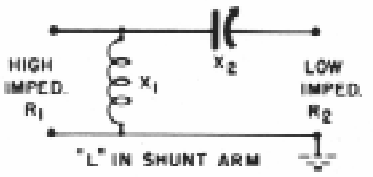
R_1 = highest of the two impedances

R_2 = lowest of the two impedances

X_1 = reactance of shunt arm

X_2 = reactance of series arm

SHUNT REACTANCE IS ALWAYS ACROSS THE HIGHEST OF THE TWO IMPEDANCES



1000 Marbles

The following article was forwarded to me from the internet by my sister. Knowing I'm a ham, she thought I would enjoy it. I did! I hope you do, too. -Ed.

The older I get, the more I enjoy Saturday mornings. Perhaps it's the quiet solitude that comes with being the first to rise, or maybe it's the unbounded joy of not having to be at work. Either way, the first few hours of a Saturday morning are most enjoyable.

A few weeks ago, I was shuffling toward the basement ham-shack with a steaming cup of coffee in one hand and the morning paper in the other. What began as a typical Saturday morning turned into one of those lessons that life seems to hand you from time to time. Let me tell you about it.

I turned the dial up into the phone portion of the band on my ham radio in order to listen to a Saturday morning swap net. Along the way, I came across an older sounding chap, with a tremendous signal and a golden voice. You know the kind; he sounded like he should be in the broadcasting business. He was telling whomever he was talking with something about "a thousand marbles." I was intrigued and stopped to listen to what he had to say.

"Well, Tom, it sure sounds like you're busy with your job. I'm sure they pay you well but it's a shame you have to be away from home and your family so much. Hard to believe a young fellow should have to work sixty or seventy hours a week to make ends meet. Too bad you missed your daughter's dance recital" he continued, "Let me tell you something Tom, something that has helped me keep a good perspective on my own priorities." And that's when he began to explain his theory of a "thousand marbles."

"You see, I sat down one day and did a little arithmetic. The average person lives about seventy-five years. I know, some live more and some live less, but on average, folks live about seventy-five years. Now then, I multiplied 75 times 52 and I came up with 3900, which is the number of Saturdays that the average person has in their entire lifetime."

"Now, stick with me, Tom, I'm getting to the important part. It took me until I was fifty-five years old to think about all this in any detail" he went on, "and by that time I had lived through over twenty-eight hundred Saturdays. I got to thinking that if I lived to be seventy-five, I only had about a thousand of them left to enjoy. So I went to a toy store and bought every single marble they had. I ended up having to visit three toy stores to round up 1000 marbles. I took them home and put them inside a large, clear plastic container right here in the shack next to my gear." "Every Saturday since then, I have taken one marble out and thrown it away. I found that by watching the marbles diminish, I focus more on the really important things in life. There is nothing like watching your time here on this earth run out to help get your priorities straight."

"Now let me tell you one last thing before I sign-off with you and take my lovely wife out for breakfast. This morning, I took the very last marble out of the container. I figure that if I make it until next Saturday then I have been given a little extra time. And the one thing we can all use is a little more time."

"It was nice to meet you Tom, I hope you spend more time with your family, and I hope to meet you again here on the band. This is a 75 Year Old Man, K9NZQ, clear and going QRT, good morning!"

You could have heard a pin drop on the band when this fellow signed off. I guess he gave us all a lot to think about. I had planned to work on the antenna that morning, and then I was going to meet up with a few hams to work on the next club newsletter. Instead, I went upstairs and woke my wife up with a kiss. "C'mon, Honey, I'm taking you and the kids to breakfast."

"What brought this on?" she asked with a smile." "Oh, nothing special, it's just been a long time since we spent a Saturday together with the kids. And hey, can we stop at a toy store while we're out? I need to buy some marbles...." □

Along with the e-mail containing the above story, the recipient was advised that it had been sent by a caring friend. It also contained a request that the reader send it on to all of his/her friends. That's why I've sent it to you! -Ed.

Editor's Choice

Many apologies for the brevity of this issue, but I had to get this it out before going off on vacation.

The DX Digest was purposely omitted since the info in it would be stale by the time you received it. Besides, you all have the URL's for the websites and can get more current information directly from there. I'm not really certain of the value of that column anyway. I've not heard comments, either pro or con about it and, if it's of little value to you, the reader, it doesn't make a whole lot of sense to continue it. So, unless I hear to the contrary, I'll probably discontinue it after the next (October) issue. It's a LOT of work to edit it each month.

For that matter, the whole doggoned publication is a LOT of work each month and I get the distinct feeling that it wouldn't matter what was in it. Very few members tend to respond to its content.

A case in point is the recent announcement of a patch design contest for Visalia 2003. To date, I have not received even so much as a single inquiry about it, much less an entry. Is anyone interested? Does anyone care?

What's the point of expending the effort every month and incurring all of the

(Concluded on Page 7)

Leftover Picnic Pictures By W6KM & W6YD

Gerry & Bill Maurer, WB6JJJ and Pat Letrich

W6KM (alias, "Firebug")

AD6MF & K6TS

NQ6X & Gwen Vallio

Sylvia & George, W6YD

W6KM & WB6JJJ

AD6MF, KE6TFS, K6RK & W6TWO (That's K6TA in the Background)

Gwen Vallio

AD6MF, K6TS & W6OD

Ray Balcher, K6VX

Attached is a photo I took of long time NCDXC'er Ray, K6VX with my XYL Kay, K6KO. Photo was taken Aug 2, 2002 in Portland Oregon at the Northwest DX Convention.

Old timers will remember Ray for his flamboyant style and wit (some might say rabble-rouser). Ray now lives on 40 acres in Siskiyou County in Northeast California with 6 towers including a full-size 3 element, 40 meter Yagi at 130 ft.

At age 77 he still does his own tower work.

Ken, K6TA

Editor's Choice

(Continued from Page 6)

expenses necessary to publish a document that nobody seems to really care about? For that matter what's the point in continuing the Club at all, when the great majority of its members appear to care little or nothing at all about it?

Another case in point: election of officers occurred at the June meeting and we failed to elect a President, because nobody was willing to stand up and say, "I'll do it!" And to date, still nobody has stepped forward.

The list of Past Presidents sent to me recently by Ron Panton, W6VG,shows that many of them served twice.

Bob Thompson, K6SSJ (SK), Len Geraldi, K6ANP, Ron Panton, W6VG, Ted Algren, KA6W and Dick Letrich, W6KM all served twice as President. Chuck Patterson, K6RK has served THREE times and, as Vice President, is again serving as your "acting President". In my mind it's unconscionable that you, the membership, should sit back and allow that to happen.

So, who among you will step up and volunteer to lead the Club just once? Surely someone out there has the balls to stand up and be a man. Or would you all prefer to whimp out, hide behind your radios and let the Club go the way of the dinosaur? It's YOUR CHOICE!

George, W6YD

Kudos 'n Kredits

This month's issue was made possible by articles and input from the following sources:

Dot Larimer (My Sister)
W6KM, Dick Letrich
K6RK, Chuck Patterson
K6TA, Ken Anderson
W6WB, Bud Bane

Thank you, one and all!

George, W6YD

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FIRST CLASS

Back to School

September 2002